2017-DSE
ICT
PAPER 2D

HONG KONG EXAMINATIONS AND ASSESSMENT AUTHORITY

HONG KONG DIPLOMA OF SECONDARY EDUCATION EXAMINATION 2017

INFORMATION AND COMMUNICATION TECHNOLOGY

PAPER 2D

Software Development

Question-Answer Book

11.15 am – 12.45 pm (1 hour 30 minutes)
This paper must be answered in English

Please stick the barcode label here.

Candidate Number									
Programming Language Used (Please tick one)	Pascal ☐								
	C ☐								
	Visual Basic ☐								
	Java ☐								

INSTRUCTIONS

(1) After the announcement of the start of the examination, you should first write your Candidate Number in the space provided on Page 1 and stick barcode labels in the spaces provided on Pages 1, 3 and 5.

(2) Tick the appropriate box for the programming language used. **No marks will be awarded if you tick either more than one box or no boxes.**

(3) **ANSWER ALL QUESTIONS.** Write your answers in the spaces provided in this Question-Answer book. Do not write in the margins. Answers written in the margins will not be marked.

(4) Supplementary answer sheets will be supplied on request. Write your candidate number, mark the question number box and stick a barcode label on each sheet, and fasten them with string **INSIDE** this book.

(5) No extra time will be given to candidates for sticking on the barcode labels or filling in the question number boxes after the 'Time is up' announcement.

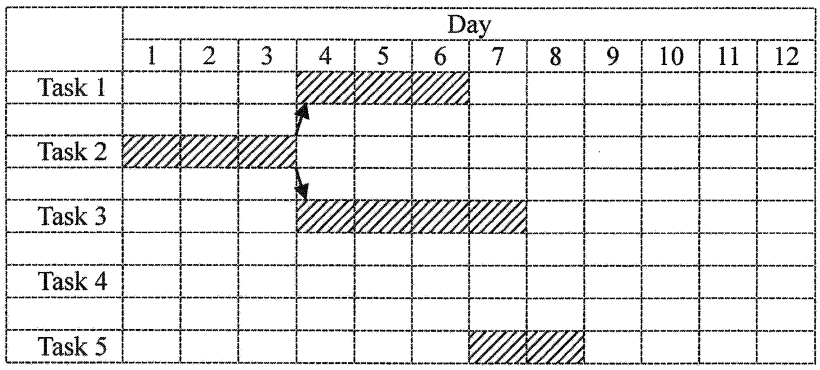
Answer all questions.

1. Mary is going to develop a project management system, PMS. Users can use PMS to draw Gantt Charts.

The following table shows the durations and dependencies of the tasks in a project `prjX`.

Task	The task(s) it depends on	Number of days needed
1	2	3
2	–	3
3	2	4
4	1, 3	3
5	1, 2	2

(a) (i) Complete the Gantt Chart for `prjX` below.



(ii) What is the critical path of `prjX`?

_____

(iii) What is the minimum number of days needed to complete `prjX`?

_____

(5 marks)

Mary considers using a two-dimensional array `M` to store the dependencies of tasks in `prjX`.

If task `i` depends on task `j`, `M[i, j] = T` ; otherwise `M[i, j] = F`.

(b) (i) Complete `M` below according to the dependencies of the tasks in `prjX`.

`M`:

i \ j	1	2	3	4	5
1	F	T	F	F	F
2	F	F	F	F	F
3					
4					
5					

Answers written in the margins will not be marked.

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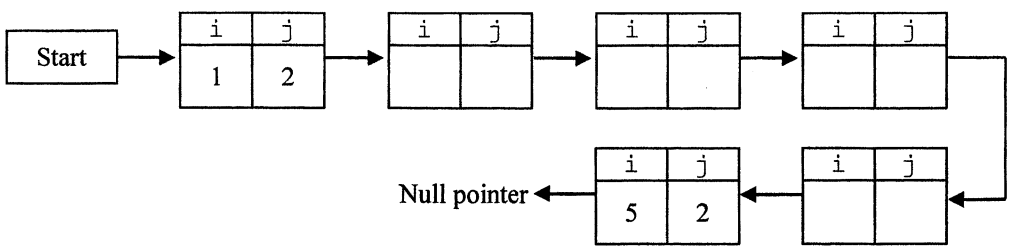
Please stick the barcode label here.

(ii) Write pseudocode to print out all dependencies of tasks in `prjX`.

(5 marks)

(c) Mary considers using the following linked list to store the dependencies of tasks in `prjX`. Each node (`i`,`j`) represents a dependency in which task `i` depends on task `j`. Complete the linked list below.



(3 marks)

(d) When designing PMS, Mary considers various types of human-machine interfaces.

(i) Give **two** advantages of using a graphical user interface over a command line interface.

(ii) Give **two** basic components of a typical graphical user interface.

(4 marks)

Answers written in the margins will not be marked.

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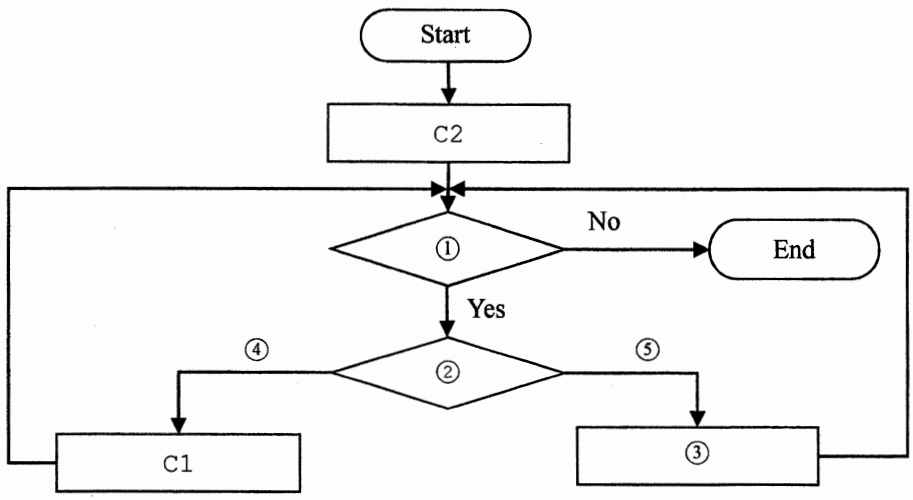
2. Subprogram `F` processes an integer array `A` of size `n`. The pseudocode for `F` is shown below:

```
Line 1:   Subprogram F
Line 2:   pos ← 1
Line 3:   while pos ≤ n do
Line 4:       if (pos = 1) or (A[pos-1] ≤ A[pos]) do
Line 5:           pos ← pos + 1
Line 6:       else
Line 7:           tmp      ← A[pos-1]
Line 8:           A[pos-1] ← A[pos]
Line 9:           A[pos]   ← tmp
Line 10:          pos      ← pos - 1
```

(a) Some commands are represented by `C1` to `C5`, as follows:

C1	pos ← pos + 1
C2	pos ← 1
C3	tmp ← A[pos-1] A[pos-1] ← A[pos] A[pos] ← tmp pos ← pos - 1
C4	pos ≤ n?
C5	(pos = 1) or (A[pos-1] ≤ A[pos])?

Complete the following flowchart diagram for subprogram `F`. Write your answers in the spaces provided.



① _____ ② _____ ③ _____ ④ _____ ⑤ _____

(4 marks)

Answers written in the margins will not be marked.

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Please stick the barcode label here.

(b) Assume that `n = 6` and `F` is executed with the following initial content of `A`:

i	1	2	3	4	5	6
the i-th entry of A	8	3	5	1	4	9

(i) What is the content of `A` when the value of `pos` becomes `3` for the first time?

i	1	2	3	4	5	6
the i-th entry of A						

(ii) What is the final content of `A`?

i	1	2	3	4	5	6
the i-th entry of A						

(iii) What is the purpose of subprogram `F`?

_____

(4 marks)

(c) Assume that `n = 6` and `F` will be executed with the following initial content of `A`:

i	1	2	3	4	5	6
the i-th entry of A	1	4	2	4	7	9

How many times will Line 4 of `F` be executed? _____

(2 marks)

(d) (i) In what situation will the number of times Line 4 of `F` is executed be minimal?

_____

(ii) In what situation will the number of times Line 4 of `F` is executed be maximal?

_____

(2 marks)

Answers written in the margins will not be marked.

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(e) A compiled language instead of an interpreted language is chosen to write subprogram `F`. Give **two** reasons to support the choice.

_____

_____

_____

_____

(2 marks)

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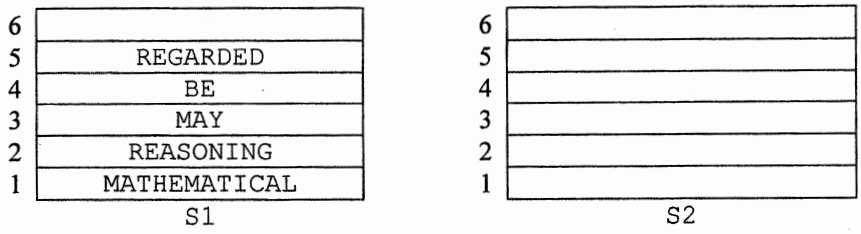
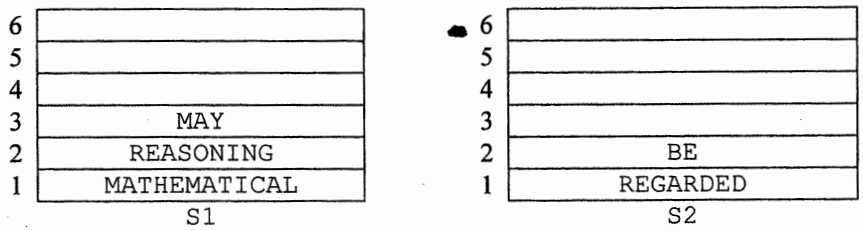
3. John is going to develop a text editor. Only words will be typed into the editor. He uses two stacks `S1` and `S2` to set up an UNDO button and a REDO button. `S1` stores the current typed words while `S2` is temporary storage. When the UNDO button is clicked, the latest typed word will be removed from `S1`. When the REDO button is clicked, the latest removed word will be restored to `S1`.

For example, after the sentence 'MATHEMATICAL REASONING MAY BE REGARDED' is typed, the contents of `S1` and `S2` are:



When the UNDO button is clicked twice, the contents of `S1` and `S2` are:



(a) Describe the stack operations involving `S1` and `S2` for the following cases.

(i) The UNDO button is clicked.

(ii) The REDO button is clicked.

(iii) `S1` is empty and the UNDO button is clicked.

(3 marks)

(b) Assume that `S2` is full. Suggest a way to handle these stacks.

(1 mark)

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(c) When developing the text editor, acceptance testing, system testing and unit testing will be carried out. Give the correct sequence of the testing stages and explain briefly the use of each testing stage.

(4 marks)

(d) John considers some programming languages to develop the text editor.

(i) Give an example of an object-oriented language and an example of a non object-oriented language, other than Pascal, C, Java and Visual Basic.

Object-oriented language: _____

Non object-oriented language: _____

(ii) Give **three** criteria for selecting a programming language.

(5 marks)

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4. Two-dimensional arrays `P` and `B1` are used to represent an image with 3×3 pixels and an image with 5×10 pixels respectively. In the arrays, `T` and `F` represent black and white pixels respectively, as shown in the following example:

`P:`

	1	2	3
1	T	F	T
2	T	T	T
3	F	F	T

`B1:`

	1	2	3	4	5	6	7	8	9	10
1	T	F	T	F	F	F	F	F	F	F
2	T	T	T	F	T	F	T	F	F	F
3	F	F	T	T	T	F	T	F	F	F
4	F	F	F	F	T	T	T	F	F	F
5	F	F	T	F	T	F	T	F	F	F

Peter plans to write a pattern matching program to count the number of occurrences of `P` in `B1`. In the example above, there are two occurrences of `P` in `B1`.

(a) Observe the following case:

`P:`

	1	2	3
1	T	F	T
2	T	T	T
3	F	F	T

`B1:`

	1	2	3	4	5	6	7	8	9	10
1	T	F	T	F	F	F	F	T	F	T
2	T	T	T	F	T	F	F	T	T	T
3	T	T	T	T	T	F	T	F	F	T
4	F	F	F	F	T	T	T	F	F	F
5	F	F	F	F	F	F	T	F	T	F

How many occurrences are there of `P` in `B1`? _____

(1 mark)

Peter writes a subprogram `Compare(i, j)` where `i` and `j` are integer input parameters. `Compare` checks if `P` matches the image assembled by `B1[i, j]` to `B1[i+2, j+2]`. It returns '`TRUE`' if there is a match; otherwise, it returns '`FALSE`'.

(b) Complete the pseudocode for `Compare` below.

```
Compare(i, j)
  for a from 1 to 3 do
    for b from 1 to 3 do
      if P[ [          ] , [          ] ] <> B1[ [          ] , [          ] ]
        return [          ]
  return [          ]
```

(4 marks)

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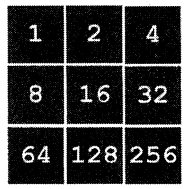
Peter considers another method, calculating a K value for every 9 (3×3) pixels. 9 values, 2^0, 2^1, ..., 2^8 (i.e. 1, 2, 4, 8, 16, 32, 64, 128 and 256) are used to represent 9 black pixels, as shown below. K is the sum of the values that represent the black pixels in image P.



P:

	1	2	3
1	T	F	T
2	T	T	T
3	F	F	T

Hence, for image P in the example above, K = 1 + 4 + 8 + 16 + 32 + 256 = 317.

(c) (i) Find the value of K for the following image.

P:

	1	2	3
1	T	T	T
2	F	T	F
3	F	F	F

(ii) Peter writes a subprogram FindK to find the value of K for image P that is represented by temp[1, 1] to temp[3, 3]. Complete the pseudocode for FindK below.

```
FindK
    K ← 0
    x ← 1
    y ← 0
    Multiple ← [          ]
    for i from 1 to 9 do
        y ← y + 1
        if y > 3 then
            x ← x + 1
        [          ]
        if temp[x, y] = 'T' then
            K ← [          ]
        Multiple ← [          ]
    return K
```

(5 marks)

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For image `B1`, an integer array `B2` is used to store the corresponding `K` values. The value in `B2[i, j]` is the `K` value for the 9 pixels from `B1[i, j]` to `B1[i+2, j+2]`. In the following example, the values in `B2[1, 1]` and `B2[2, 1]` are given.

`B1:`

	1	2	3	4	5	6	7	8	9	10
1	T	F	T	F	F	F	F	T	F	T
2	T	T	T	F	T	F	F	T	T	T
3	F	F	T	T	T	F	T	F	F	T
4	F	F	F	F	T	T	T	F	F	F
5	F	F	F	F	F	F	T	F	T	F

`B2:`

	1	2	3	4	5	6	7	8
1	317							
2	39							
3								

(d) (i) What is the value in `B2[3, 1]`? _____

(ii) Describe how to use searching and `K` values to find the number of occurrences of `P` in `B1`.

_____

_____

_____

_____

(3 marks)

(e) (i) Suppose that a sequential search is used and there is no occurrence of `P` in `B1` in (d)(ii). How many comparisons involving the values in `B2` will have been done during the searching process?

_____

(ii) Someone suggests that binary search could be applied in order to improve the efficiency of the pattern matching. Do you agree? Explain briefly.

_____

_____

_____

_____

(3 marks)

END OF PAPER

Answers written in the margins will not be marked.

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